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ABSTRACT

The Star Schools Assistance Program has been funding activities since 1988. It provides projects with seed money to develop distance learning programming and equip sites. In addition, Star Schools has served as a focal point for demonstrating innovative uses of technology to advance educational opportunity and improvement. This paper represents the first part of a 2-year evaluation of Star Schools. Site visits, interviews, and document reviews of eight Star Schools programs in more than 80 schools provided evaluation information. The Introduction of this report provides background information about the Star Schools Program and it includes a discussion of the implications of amendments to the Star Schools Program Assistance Act for the evaluation study. The second section presents preliminary findings from the evaluation. Among the implementation issues discussed is how technology is used to support student or teacher learning. The report concludes with a summary of findings foremost of which is that the seed money function of the program (achieved with high initial costs) can be supported, but that seed money alone is not enough to further distance education. As demonstration programs, the Star Schools provide valuable examples for educational opportunity improvement. Six tables illustrate the discussion. (Contains 9 references.) (SLD)

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American Educational Research Association Annual Meeting
New Orleans
April 1994

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THE STAR SCHOOLS DISTANCE-LEARNING PROGRAM: RESULTS FROM THE MANDATED STUDY

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INTRODUCTION

During the past decade, new communication delivery technologies have proliferated. Such technologies include satellites with microwave receivers, fiber-optic and coaxial cable television, teleconferencing systems, fax machines, and nationwide computer networks. Simultaneously, several independently organized efforts have attempted to use these "distance-learning" technologies to deliver what they intended to be high-quality experiences to elementary and secondary school students and teachers. These efforts exist at local, county, and regional levels and involve audiographics; two-way computer conferencing with audio interaction; instructional television fixed service (ITFS); one-way broadcast or point-to-point audio, data, and video, with the possibility of audio return; and microwave, two-way point-to-point audio, data, and video transmission. Each technology, with its strengths and limitations, continues to be used in various localities to increase student access to learning opportunities, but there is no consistency across the nation.

The federal government, through the Star Schools Program Assistance Act (20 U.S.C. 4081), has encouraged:

> ...improved instruction in mathematics, science, foreign languages, and other subjects, such as literacy skills and vocational education...to serve underserved populations, including disadvantaged, illiterate, limited-English proficient, and disabled students through distance learning technologies. (Education Acts, Amendments, 1991)

The Office of Educational Research and Improvement (OERI) of the U.S. Department of Education has provided funding for three successive cycles of two-year Star Schools projects. At this stage in the development of the new communication-delivery technology, it is appropriate to assess the early efforts supported by federal funds. Indeed, Congress recognized the importance of such a study by including a requirement for an evaluation of the Star Schools Program in the 1991 reauthorization. This paper is based on the mandated report to Congress. It represents the first part of a two-year evaluation of Star Schools being carried out by the Southwest Regional Laboratory (SWRL) and Abt Associates Inc. (AAI).

The evaluation focuses on a series of questions posed in the authorization of Star Schools. The following questions address issues related to project organization and impact on students, staff, and schools.

Project-oriented:

1. What activities were supported by grantees?

   - student programming;
   - staff development; and
   - administration.

Student-focused:

1. How many students participate in Star Schools-sponsored activities? What are their demographic characteristics? Are there differences in services offered to economically and educationally disadvantaged and minority children? Are there differences in effectiveness of programming and services?

2. How effective were Star Schools courses?

Staff-focused:

1. How were studio teachers selected? What support did they receive?

2. How were the staff members responsible for distance learning at the school site selected? What support did they receive?

3. What staff development programs were offered? To how many teachers? With what effects? How much time was spent in staff development?

The Introduction of this report provides background information about the Star Schools Program and it includes a discussion of the implications of amendments to the Star Schools Program Assistance Act for the evaluation study. The Introduction also contains the conceptual framework for the evaluation, as well as a description of the evaluation design and methodology, and a discussion of the limitations of the study.

The second section presents preliminary findings from the evaluation. The information is largely descriptive in nature. Findings include information about federal and state influences on Star Schools distance-learning programs, as well as implementation issues and effects of the program. Among the implementation issues discussed is how technology is used to support student or teacher learning. Information also is provided about effects of program activities on staff and schools, as well as on students.

The report concludes with a summary of findings and discussions of their implications for policy.

The Star Schools Program Assistance Act

The Star Schools Program was authorized in fiscal year (FY) 1988 for a five-year period. In 1991 authorization was extended to FY 1993. In 1988 the Department of Education spent about $19 million on the first four Star Schools projects. In FY 1992, the Star Schools Program funded projects totaling approximately $13 million; in FY 1993, the amount spent on general projects was $13 million, with an additional $4 million on a statewide demonstration project, $1.6 million on dissemination, and $.5 million on evaluation. The Star Schools Program supports a variety of services, including:

- developing or acquiring programming in various curriculum areas;
- supporting teacher training and staff development to improve instruction in mathematics, science, and foreign languages;
- providing tutorial services for students by using a variety of technologies;
- maintaining testing services for the courses offered; and
- supporting the acquisition of telecommunications facilities and equipment, both by projects and by participating schools.

The two authorizations of the Star Schools Program contain somewhat different conceptions of the program. The conceptions are different along two dimensions. The first dimension is one of program definition; that is, whether Star Schools is a demonstration or seed money program, or both. The second dimension focuses on the nature of the programs offered through distance learning, including whether the primary focus is offering courses not otherwise available or as supplements to existing curriculum. A discussion of each of these issues follows.

Although the original authorization for Star Schools contained the word "demonstration," it was eliminated in the 1991 legislation, except for the authorization of a demonstration statewide fiber-optics network. This change clarified what could have been different, but not necessarily competing, purposes for support. Demonstrations, in general, involve showing the efficacy and value of an approach so that it is not only absorbed into the practice of the demonstrators but is adopted by others. With demonstrations, evaluations must address not only the success of the program at the developer site, but also the extent to which it was or could be adopted elsewhere. In contrast, seed money is provided when organizations or individuals need help in getting started with a program or practice, but are seen as being able to continue it when the funding runs out. Telecommunications-based distance learning is, on the face of it, a prime candidate for receiving seed money, which can be used to buy expensive equipment and develop complex programs. The

evaluation question, beyond effectiveness, is whether local sites have the resources to continue the program.

The resource question is, of course, related to the cost of equipment for telecommunications technology. Although never conceived of as an "equipment" program, Star Schools included funding for acquisition of necessary materials. The original four projects received large grants to purchase equipment, and the 1991 authorization included the following provision, "Not less than 25% of the funds available to the Secretary in any fiscal year under this title shall be used for telecommunications facilities and equipment." However, it also provides that projects "will use existing telecommunications equipment, where available." The shift recognizes that telecommunications technology is now more widely available than at the start of the program. Consequently, recipients of Star Schools funding can increase their impact by providing services to schools and districts that already own equipment.

In fact, despite the use of the word "demonstration," OERI, the office of the U.S. Department of Education through which Star Schools is administered, officials, and Star Schools projects always saw the Star Schools Program more as one providing seed money than as one designed to develop exemplary programs, with the notable exception that Star Schools became a key program to demonstrate educational applications of "cutting-edge" technology. Such demonstration is particularly important during the third funding cycle in which one project demonstrates a statewide use of fiber optics and another demonstrates innovative uses of computer networks.

Conceptually, a third approach exists on the same dimension. Federal programs can exist to provide continuous support for a particular population (e.g., low-achieving disadvantaged students) or to achieve a particular goal. Although some individuals within the distance-learning community believe Star Schools should be so construed, that view is not contained in the legislation.

The second dimension on which there were changes in legislation that influence Star Schools activities concerns the nature of distance-learning programming. Originally, Star Schools focused primarily on providing courses to students who would not otherwise have access to them. In general, such students live in isolated, rural areas or attend schools that do not offer the full range of courses because most of the students at their schools require some kind of remedial instruction. For example, in some urban settings there are few advanced placement or other enrichment courses. Star Schools programming is one method of providing high-performing students in those schools with challenging curricula. Secondarily, Star Schools could provide models of excellent

instruction to supplement rather than replace existing courses. Indeed, some Star Schools activities, although delivering instruction to students, have a major goal of changing teaching practices.

The 1991 amendments strengthened the secondary emphasis. The goal of the program is "...to encourage improved instruction..." Further strengthening comes from the addition of a clause that focuses on activities "...integrating programs into the class curriculum" and the requirement that projects "provide assurances that...programming will be designed in consultation with professionals who are experts in the applicable subject matter and grade level."

From an evaluation perspective, the change means that the study must address two separate questions. First, it must seek answers to questions about the efficiency and effectiveness of distance learning in providing full-course instruction to students who do not have access to particular content areas. Second, it must ask about the added value of Star Schools activities to existing curriculum and efforts to improve teaching and learning.

One other change in legislation is of particular note. Originally, consortia could only receive Star Schools funding for one two-year cycle. The 1991 amendments allowed previously funded projects to receive new funding if they:

- continued to provide services in the subject and geographic areas that earlier funding supported; and
- used new grant funds to expand services by increasing the numbers of students, schools, or school districts served with existing courses; providing new courses; or serving new populations, "such as children or adults who are disadvantaged, have limited English proficiency, are disabled, are illiterate, lack high school diplomas or their equivalent."

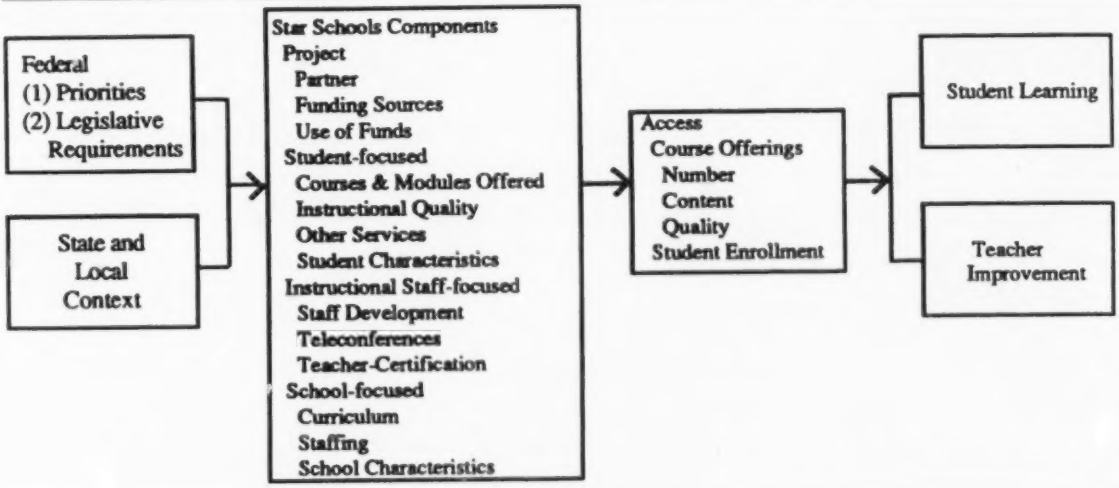
Indeed, the majority of recipients of third-cycle funding had received Star Schools funding in earlier cycles. The change had major implications for the projects but little for the evaluation design.

Evaluation Approach

Conceptual Framework

Figure 1 displays the conceptual framework that guided the study.

Figure 1
Conceptual Framework



The evaluation focused on two aspects of the context for the Star Schools Program. First, the federal context influences the organization of the Star Schools projects as well as the services they provide. The federal context includes not only the legislation but changes in priorities. For example, when the authorizing legislation was passed in 1988, the National Education Goals had not yet been formulated. They are now significant objectives for Star Schools activities. One consequence is that science and mathematics programs developed during the first cycle of funding have a somewhat different content and focus from those developed later.

Legislative requirements form the second aspect of the federal context. Some of these have not changed from the inception of the program. For example, the law mandates that projects be multistate consortia and have at least three partners. These requirements had an impact on the way projects were organized and the issues and problems they faced. In addition, the requirements affected the functioning of distance-learning activities in the funded organizations after federal funding ceased. The multistate consortium requirement meant that projects confronted issues of teacher certification, as well as coursework and testing requirements, across state jurisdictions.

Funded projects addressed these issues in a variety of ways that involved operations, service delivery, and the targeting of activities. In addition, the statute requires at least one half of the schools served to be Chapter 1 schools[1]. This requirement affected programming and service delivery. Finally, as noted above, there were changes in the legislation in 1991. For the most part, these changes clarified existing practices or opened new possibilities for funding.

The second set of contextual issues comprises state and local characteristics. These issues had an impact on the effectiveness of Star Schools projects in several ways. First, some state regulations, particularly those that raised high school graduation or state university entrance requirements, helped create a market for distance-learning projects. Isolated rural schools employ distance-learning technologies to ensure opportunities for their students and to comply with state regulations. Second, state and local regulation created barriers to the effectiveness of distance-learning technologies. For example, different requirements for certification in a subject area in different states and regulations or contract agreements that require the presence of a teacher certified in the subject being taught in the classroom precluded participation, on occasion, in Star Schools activities. At the minimum, certification issues required projects to develop agreements with a number of states.

Local contextual issues include demographic and geographic information. Perhaps more important, however, the local context provides academic and other experiences for students and teachers that influence the effectiveness of distance-learning programs. For example, the local context provides students with prior opportunities to learn. Students who come to advanced physics classes, for example, well-prepared in trigonometry and calculus, are more likely to succeed than students who take physics with weaker preparation. Local context also includes the qualifications of teachers who prepare students and those who support distance-learning activities.

The effectiveness of Star Schools activities that are integrated into existing course-work or are designed to improve teaching are particularly influenced by local context. Student learning in courses that combine school-site and distance-learning opportunities, for example, is likely to vary depending on the quality of teacher implementation of curriculum and instruction. Similarly, the effectiveness of activities aimed at instructional improvement will be influenced by improvement efforts at the local site as well as by other staff development opportunities available to teachers.

The contextual issues also influence the organization and service offerings of the Star Schools projects. Of particular interest within the conceptual framework are the project-focused,

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[1] Chapter 1 is the single largest federal elementary and secondary education program. It is designed to provide supplemental services to low-achieving students in low-income schools.

staff-focused, student-focused, and school-focused questions raised by Congress and OERI. The framework provides a method for organizing descriptive information about such matters as the number of students served, the types of services they receive, and demographic and geographic distribution of services in a manner that facilitates analyzing relationships between those matters and the context and condition under which services are received. It also enhances analysis of the relationship of the objectives of particular activities to the distribution of services and to their effectiveness in achieving their own goals.

Various configurations of Star Schools services affect students' access to learning opportunities. Indicators of access are course offerings (the number and content), student enrollment, and student access to quality teaching.

Finally, the outcomes are student learning and improved instruction.

Methodology

The first year of the evaluation relied primarily on qualitative data collection procedures. It was designed to yield defensible understandings of the existing Star Schools projects. It drew on the following data sources:

- a literature review encompassing research findings from distance learning-related studies and of alternative approaches to achieving the objectives addressed through Star Schools activities;
- site visits to Star Schools projects and schools and to other distance-learning projects; and
- project reports.

Project agendas and site protocols, adapted from procedures described by Miles and Huberman (1984), provide a means of integrating the data from the various sources. Project reports were analyzed using a content analysis procedure that provided quick retrieval of project-generated information about each element in the conceptual framework (Marshall & Rossman, 1989). The information was then included in project agendas that, in turn, were used to generate site protocols. The site protocols identified the individuals to interview and events to observe during the site visits to Star Schools projects and schools. One use was to highlight "missing" information that must be gathered on site. Another was to indicate the questions that probed more deeply into project activities, organization, and impact than was possible from written documents. During the analysis phase, the project agendas provided a means of integrating qualitative data collected on site and quantitative data gleaned from project documents.

The first phase of the study involved data triangulation; that is, collecting information from multiple sources using multiple methods. Staff collected descriptions of activities from project-generated documents; interviews with project staff, staff from participating institutions, and the recipients of services; and observations of the activities.

During the first year, staff visited all projects. The site visits included visits to project headquarters, with interviews of key staff, and visits to at least two schools served by the project, one of which was close to headquarters and another distant from it. At least one visited school was a Chapter 1 school. Projects were asked to suggest "best-case" schools in each category—that is, schools in which distance-learning activities are well-implemented. Using best-case schools, with a particular focus on Chapter 1 schools, enhanced the opportunity to provide information about the potential of distance learning. Further, individuals at such sites productively reflected on the problems they encountered and how they overcame them, thus providing useful information about how to structure policy related to distance-learning implementation.

Two-person teams conducted the site visits. They spent at least four days on site, two at project headquarters and one at each school. The site visits had three purposes:

1. They provided the opportunity to confirm and extend the information gleaned from project documents.

2. They yielded information that addresses the evaluation questions associated with project organization, perceived effects of federal requirements, and actual school-level experiences with Star Schools. The site-visit information was particularly important in addressing questions about the effectiveness of telecommunications partnerships programs and services after federal funding ceased.

3. The site visits served to focus Phase 2 data collection and analysis plans.

In addition to interviewing project staff and teachers and school site administrators, staff observed Star Schools classes. The major purpose of the observations was to gain insights into the degree to which students have the opportunity to interact with one another and with the distance-learning teacher, student responses, and the role of the on-site facilitators.

The information collected on site was synthesized by the site-visit team following its visit. Team members reread interview notes, notes from observations, and project documents, and coded information according to the conceptual framework. They prepared an interpretive summary of their findings, which served two purposes. First, it provided a concise statement of the progress and problems of a particular Star Schools project. Second, it contained tentative analyses that explained the status of the project.

In analytic meetings, site visitors reviewed the interpretive summaries to develop what Yin (1981) calls "causal arguments" both within and across cases. The causal arguments were used to identify the existence of phenomena in more than one case under predictable conditions. For example, a preliminary analysis revealed that the use of taped, as contrasted with live, broadcasts was related to the structured broadcast schedules, which met project needs to provide regular service, but conflicted with in-school schedules. The causal argument is that the combination of rigid technologies and organizational inertia leads to creating flexible use of programming. The analytic meetings followed procedures recommended by Miles and Huberman (1984), which culminate in conclusions about Star Schools and its activities. These conclusions were then framed in terms of the literature in completing this preliminary interim report.

Limitations of the Paper

This paper accurately reflects current information about the Star Schools Program. It provides descriptive information about project operation, the numbers and types of students and schools reached, and the role of the on-site facilitator and teacher. Equally important, the report contains information about how Star Schools projects spent federal funds and how funds from other sources were used to extend the implementation of the activities. It also provides policy-relevant information about how Star Schools distance learning is used at school sites, the ways such programs are combined with others at some sites, the perceived value to students and schools, how federal and state context influence the use of distance learning at the school level, and reported effects on the organization of curriculum and instruction. In addition, the report includes well-grounded recommendations for policy and future study. The report also includes an evaluation of the relationship of federal requirements to the operation of the program and recommendations for potential changes in how the program is organized. In sum, this first year of a two-year study provides useful knowledge to policymakers as they consider the value of the Star Schools Assistance Program and ways to enhance its positive effects.

At the same time, the report has limitations, all stemming from its timing. First, although site visits were made to all Star Schools projects, at least two Cycle 1 projects kept few records of their Star Schools years, and one was no longer providing distance-learning opportunities to schools. Consequently, information about those projects is more limited than information about others. Also, the remaining projects had adjusted programming to accommodate the end of federal funding. While such adjustments constitute important information included in this report, they also limit the evaluators' ability to see Star Schools as it originally operated. Second, the report relies heavily on project-generated evaluations, which varied greatly in quality, and perceptions of Star Schools project staff and teachers who received services. Consequently, although the report

provides information about probable impacts on teachers, schools, and students, it will be important to gather independent data about those impacts. It is equally important to gather data relating impacts to federal and state contexts, project organization and processes, and the type of distance-learning activities. These will be pursued during Phase 2.

Finally, the report includes some speculation about how the impact of Star Schools distance learning can be enhanced.

Despite its limitations, the report has many values. It contains clear descriptive information, documented associations, and grounded policy recommendations. Although an interim report, it goes farther than previous research to document and evaluate Star Schools distance learning, its possibilities and problems.

Summary of Project Features

The projects differed in many ways. Although satellite-based instruction with audio return was the dominant application of technology, multiple technologies were used across the projects. Some included fax machines and compressed data transmission as well as telephones to receive student questions, assignments, and feedback. In addition, one project made heavy use of computer networks. Another presented participants with a menu of technologies, including computers, modems, electronic mail, laser disk players, and video cassette recorders.

Projects also differed in the programming they offered. Some focused primarily on offering courses to high school students in subjects to which they would not have had access otherwise. Others included primarily supplemental courses at the elementary and middle grades. Still others provided adult literacy and vocationally oriented courses. Some mixed a variety of program foci. All included staff development for teachers.

Organizationally, there were different configurations of partnerships, dues structures, and user fees.

Table 1 summarizes the key project features.

Table 1
Cross-Project Description Key Project Features

Project	Courses	Type	Goal	Principal Partner types	Courses Developed by:	Still Offered?	Funding Cycle
CETC	ES math and geography, French and Spanish MS math, computer, and earth science HS calculus (AP and general) and Japanese and Mandarin Chinese	Full year	High quality for urban disadvantaged	Universities and colleges	Universities and colleges	Yes	2
MCET	MS math and science modules	4-8-week blocks	Models of effect. instruction	State education agencies and private organizations	MCET and private organizations	Yes	2 and 3
Midlands	Russian, basic English and reading course, one AP class	Full year	Access	Universities	Universities	No	1
SERC	HS foreign languages, statistics, discrete math, precalculus and calculus, AP economics, physics, honors geography MS integrated science	Full year	Access	State education agencies and PBS	Public broadcasters in four states	Yes	1 and 3
STEP	ES basic skills MS career paths; science and technology; principles of technology HS applied math	Full year and one 6-week ES	Access	State education Agencies and two private organizations	STEP/Star	Yes	2 and 3
TEAMS	ES Science and math modules	4-8-week blocks	High quality for urban disadvantaged	Large urban school districts	Los Angeles County Office of Education	Yes	2 and 3
TERC	MS and HS science and math modules	6-week blocks	Models of effect. instruction	Universities and colleges and private organizations	TERC staff	No	1
TI IN D	HS biomedical prep, career guidance , Algebra, Physical science, Math/science counseling institute	Full year	Access	Universities	Universities and state education agencies	Yes 1	1

FINDINGS

This section includes the findings of the first year of the study and focuses on the context for the Star Schools Program, particularly the influence of the federal role and state regulations and requirements. State-level issues provided challenges to Star Schools programming because of requirements related to teacher certification and course approval, but also created demands for programs through changing high school graduation requirements and standards for admission to state institutions of higher education.

This section also presents information about staffing, both at the project level and within schools and districts. In addition to discussions of how studio teachers were selected and supported, the section includes information about the responsible adults at the school site. For example, it provides information about how they were selected, the roles they played (e.g., whether they served as facilitators or coteachers), and the support they received.

In addition, this section focuses on schools involved in Star Schools-sponsored activities. Particular attention is paid to reasons schools got involved and Star Schools activities in which schools participate.

This section concludes with a discussion of the effects of Star Schools, including student course enrollments, anecdotal information on student outcomes, and changes in teachers' attitudes and behaviors.

Context

Federal Role

The Star Schools Assistance Act contained requirements that presented no problems to projects as well as ones that provided challenges.

The first category included a requirement that at least 50% of the schools served were Chapter 1-eligible schools and that Star Schools projects were partnerships of at least three organizations. The organizations could include profit-making firms. Neither of these requirements was problematic for the Star Schools projects.

Given the target groups, projects were virtually assured that participating schools would be Chapter 1-eligible. However, because so many Star Schools activities were geared to high school students and most districts allocate Chapter 1 funds primarily to elementary schools, few participating schools actually received Chapter 1 funds. Two projects noted spin-off benefits from

their association with Chapter 1: Schools participating in TEAMS used Chapter 1 funds, along with state and local funds, to purchase services; and MCET found the Massachusetts statewide Chapter 1 Computing Center to be an important resource for technical assistance on computer-related curricula and other computer activities including desktop publishing.

Organizationally, the very nature of distance learning, involving at least a sender and a recipient, and requiring expertise in subject matter, technology, and pedagogy, facilitated the development of partnerships among organizations with different types of knowledge. However, at least one project director reported that he spends a great deal of time nurturing and mediating some partnerships. He pointed to "unnatural" partnerships between state education agencies (SEAs) and some public broadcasting systems, which have no history of collaboration. Historically, there also has been competition between public broadcasting stations so he attends to facilitating collaboration to mitigate negative effects. Despite the need for nurturing, the collaboration is essential, according to the project director, because each organization provides expertise that the other lacks.

Projects reported that the benefits of partnerships were enhanced effectiveness and efficiency. TEAMS, for example, said that network building within receiving local education agencies allowed TEAMS to use a relatively small number of downlinks by strategically placing them and negotiating with cable and broadcast stations to retransmit live signals. MCET asserted that it would have used a consortium model even without a requirement to do so to avoid duplicating activities. For TERC, the advantage lay in the division of labor, with regional centers focusing on school-based issues and TERC on curriculum development and technical issues. The partnership expanded the programming base for TI IN, and BCSN built on preexisting partnerships of Historically Black Colleges and Universities to create a network of producing partners. STEP/Star staff reported that the consortium of SEAs and the fiscal agent led to improved and more frequent communication among the SEAs.

Relations with profit-making companies were positive and productive. TI IN is a profit-making company, which delivered services valued at the school sites. Two other projects, STEP/Star and MCET, had partnerships with profit-making companies, and both reported their pleasure with the high quality of products and services received. STEP/Star said the technical quality of programs had improved with the addition of the profit-making company. One participating school administrator supported this, saying, "Young people nowadays have been exposed to the very best television programming has to offer. They immediately recognize inferior or amateurish production and will not accept bad quality." MCET terms its profit-making partners "inspired" choices.

For Cycle 1 projects, two requirements were problematic. First, grants were limited to two years. Second, Cycle 1 grant recipients were not eligible for funding in Cycle 2. Although the two-year funding limit remained, previously funded projects were eligible for Cycle 3 funding.

All projects reported concern about the limited duration of the grants, and it resulted in negative effects in all cases. In broad terms, the first year of the grant was spent in getting ready to deliver services, with some limited service delivery. During the second year, school sites became comfortable with the activity and the technology, but then lost support. The problem was compounded for activities that required much curriculum development, such as the development of new courses or new materials to support existing courses. It created the most difficulties for activities, such as those sponsored by TERC, that relied on extensive and innovative uses of technology, and those that involved classroom teachers' use of multiple technologies, such as MCET.

The limited funding period is appropriate *if* Star Schools is seen as a seed money project. From that perspective, the funds are used to provide impetus for participation and to cover capital costs. Then, local sites can support the activities from their institutional funds. However, this perspective did not work well even for those courses most like traditional instruction, including advanced courses and foreign language, because instructors modified their usual practice for satellite teaching, and receiving sites frequently experienced problems as they learned to use the technology. In such projects, implementation went smoothly by the middle of the second year of the funding cycle. Additional time would allow assessment of impact and some program modification.

State Regulations and Requirements

State regulations and requirements had both positive and negative effects on projects. Some state requirements, notably those related to foreign language, helped create a demand for distance-learning courses. However, some requirements may limit schools' willingness and ability to participate in Star Schools activities. On balance, state requirements had more positive than negative effects on Star Schools.

State requirements positively influenced participation in Star Schools foreign language courses but may have had a negative impact on participation in other courses. Two projects cited either high school graduation or state university admissions requirements as creating a market for Star Schools services. However, one developer of supplementary materials reported that teachers in one state were unwilling to use them because they feared not covering material found on the college admissions test.

Generally speaking, teacher certification and time allocation requirements were only an issue for full courses in which school-site personnel are not certified in the same area. These did not serve as major barriers to Star Schools activities. Most projects used certified teachers as full-course studio teachers and worked with other participating SEAs to gain reciprocal certification, including, in one case, submitting studio teachers to a blood test required by another SEA. Projects that used university teachers as studio teachers required that classrooms be supervised by certified personnel, preferably in a subject close to that being offered. This solution enabled schools to participate, but served to limit the number of states interested in the programs, according to project personnel.

One state required that classroom, as well as studio, teachers be certified in the subject being taught. This served as a major limitation on distance-learning opportunities in that state.

Course approval did not present a problem except in two cases. The same state that required a certified teacher within the classroom rigidly applied requirements that classes meet for a defined time period, and only counted the on-air time, as did another state that refused to participate in activities designed to supplement classroom instruction offered by another project. To deal with issues of course approval, SERC noted that courses developed by teachers were sometimes reviewed by SEA specialists, particularly if they were to be used to fulfill a graduation requirement.

Staffing Issues

The processes projects used to select studio teachers and provide support to them and to school-site staff often differed between Star Schools projects that focused primarily on full-course instruction and those that highlighted supplementary course instruction.

Selection of Studio Teachers

Studio teachers were selected based on referrals, interviews, and screen tests, whether they were responsible for entire courses or for supplemental instruction. Those teachers who had gone through an interview and screen test process prior to selection were usually more successful than those who were hired only on the basis of reputation or interest and whether they were selected from among classroom teachers or university professors. When screen tests were not used, either some teachers were replaced or course enrollments dropped.

Support for Studio Teachers

All projects using satellite transmissions reported that studio teachers received support from studio production teams, particularly in preparing visual aids and graphics. As one studio teacher reported, "I had to learn from the people with a video orientation how to think in images and use pictorial things to enhance my teaching style." Further, all but two projects also reported that studio teachers received some support from curriculum specialists or other resource people. Those projects whose studio teachers did not receive support on the content of instruction were those that relied on university professors.

Selection of School-Site Personnel

The criteria for selecting school-site personnel varied with whether the distance learning was designed as whole course or supplemental instruction. For full-course instruction, the duties of school-site personnel focused on the logistics of distributing materials and classroom management. Unless states required school-site personnel to be certified teachers, the on-site facilitators typically were support staff and noncertified teachers. However, the Midlands project encouraged schools to use certified math and/or science teachers for their physics and calculus distance-learning courses, and project staff believed the courses were more effective with such school staff.

With supplemental instruction, the regular classroom teacher had to be in the classroom for the distance-learning activities. In these projects, Star Schools personnel provided some technical assistance to these teachers, who, for the most part, had volunteered to participate. In all projects, selection of school-site staff was at the discretion of individual schools or school districts; Star Schools project staff played no role in the selection of on-site staff.

Amount of Assistance Available to Individual Schools

The amount of assistance available to school-site personnel varied from project to project, with the tasks that school-site personnel undertook, and with whether the Star Schools project provided equipment.

Among those projects providing full-course instruction, assistance ranged from short (half-hour to hour) telecourses on the specific technology and general facilitator training to intensive technical support. Such intensive support included project technicians who traveled to receiving sites when technical questions could not be answered by telephone. Some projects have a school hotline, outreach visits, and quarterly calls to facilitators and schools. STEP/Star and SERC

placed greater emphasis on local assistance and were well-regarded by sites visited than did TI IN, Midlands, and BCSN. Interactions between the school-site staff and studio teachers usually depended upon the initiative and interest of the school-site staff. Formal structured interactions were infrequent, but there are cases of extensive cooperation and communication.

Generally speaking, the amount of staff development was greater when projects focused on supplemental instruction rather than on full-course instruction. MCET, for example, provided far more staff development than any other Star Schools project. All teachers participated in several one-day conferences, in a one-week residential summer institute, and in two teleconferences. Moreover, two full-time coordinators each worked with 30 schools and were available for substantial on-site technical assistance. TERC, the only project relying on computer networking, used a training pyramid, where TERC staff trained university-based staff who, in turn, worked with individual schools. Problems with the computer technology, however, precluded attention to integrating the content of the technology into classroom instruction. One supplemental project served so many schools that it was too large to provide much personal assistance to individual teachers, relying instead on print materials and teleconferences. Although each participating district had a full-time district-level person responsible for recruiting and assisting schools, almost 100 schools per district, on average, participated in the program, thus rendering even local assistance minimal.

Distance Learning as a Vehicle for General Staff Development

Six Star Schools projects provided general staff development through distance-learning satellite technology. The Star Schools projects did not devote the resources or attention to general staff development activities that they did to student-focused programming, although multiple topics were offered. The topics can be roughly grouped into the following five categories:

- particular instructional issues that may be important to a broad range of teachers without respect to content expertise, such as "Effective Programming for Chapter 1 Students" (TEAMS) and "Engaging Students in a Problem-Centered Curriculum" (TI IN);
- teaching in the content area, such as "Science in the Middle Grades" (MCET) and "Genetic Investigators: Biology for Elementary School Teachers" (BSCN);
- broad-based educational issues, such as "Site-Based Management and Effective Schools" (TI IN) and "K-8 Reform" (TEAMS);
- multicultural instructional needs, such as "Trends and Strategies in Multiethnic Education" (BSCN) and "Northwest Native American Cultures" (STEP/Star); and
- community issues of concern to teachers, such as "At Risk: Alternatives to Gang Involvement" (TI IN).

About 130 separate staff development activities were offered in the 1992-93 academic year, with some projects providing development opportunities on more than 40 topics. Neither TERC nor MCET offered general staff development but rather concentrated on the project-related staff development described earlier. Staff development opportunities varied from 1-hour to 6-hour segments, with some 10-hour segments. Rarely were graduate courses offered. Both Midlands and SERC initiated graduate course offerings through distance learning, but both dropped them either due to limited enrollments or conflicts with other providers. Teachers participating in STEP/Star staff development are eligible for college credit.

For the most part, general staff development consisted of a number of "one-shot" workshops, presented as a teleconference, rather than a sequenced set of activities. The staff development offered appeared to be extremely underused, with projects investing little in obtaining data on who participates, for how long, and with what effects. In the rare instances in which general staff development was viewed, typically through tapes of broadcasts, the materials were well-regarded. In one school, all fourth-grade teachers met weekly at a teacher's home for a "supper and in-service night." They spoke of the benefits of being able to tape the broadcasts, view them in comfortable surroundings, and then use them in grade-level collaborative planning.

Information about staff-development activities seems to indicate that Star Schools has not found a unique niche in the configuration of approaches to staff development.

School-Focused

Schools participate in distance-learning projects for a variety of reasons, according to interviews with school personnel in the schools that projects recommended as examples of "best-practice" implementation of Star Schools activities. Why schools participate may, for example, depend upon:

- state graduation or college-entry requirements that otherwise would be difficult to meet;
- desires to increase curriculum offerings available to students;
- efforts by school staff to enhance educational experiences for students;
- beliefs in the importance of exposing students to people living in other settings;
- desire to expose students to multicultural educational experiences;
- efforts by school staff to broaden parent and community participation in schools; and

- intentions to increase both faculty and student access to and comfort with technology.

Examples from the schools that were visited follow.

Schools participated because distance-learning programs allow them to comply with state education requirements otherwise difficult or impossible to meet, particularly for full-course high school instruction where the content would not be provided otherwise. Involvement in foreign language distance-learning programs, for example, was spurred by state requirements for high school graduation and college entry, and there are 11,630 high school students currently enrolled in foreign language courses. SERC produced an economics program after South Carolina began requiring that course for high school graduation.

School involvement derives in part from the need to increase curriculum offerings in settings with limited access to high quality personnel in particular areas such, as advanced math, advanced science, and AP courses. Particularly in rural areas, but also in other settings, too few students may be interested in advanced courses to warrant hiring a teacher. Given the problems rural areas have in recruiting specialized teachers and the small number of students seeking some courses, distance learning is an economically feasible approach to meeting student needs. For example, SERC full-course broadcasts are received in classes averaging six students; some classes serve as few as one student at a given site. Similarly, urban settings that have traditionally underserved students in the areas of math and science may find relatively few students ready to enroll in advanced courses.

At the high school level, one aim is to provide students with the opportunity to successfully compete for college admittance and to arrive better prepared. Access to foreign language instruction is one aspect of this goal. The next most crucial areas are math and science. Indeed, both rural and economically depressed urban area high schools currently subscribe to 11 math and science specialty courses. This broadened math and science curriculum is reaching 2,491 students.

Schools also see distance learning as a means of providing college-bound students with an opportunity to take AP courses to qualify for test-based college credits. Currently, 1,583 students are enrolled in the five AP subjects offered through distance learning. Special interest humanities, social sciences, and general skills courses and modules also are offered through distance learning. Star Schools programming enables small rural schools to enrich their curricula despite limited faculty breadth.

School staff reported using distance learning as part of a general effort to enhance educational experiences for students. For example, some schools participate in distance-learning activities because the broadcasts integrate well with existing curricula and provide access to educational experiences not normally available in traditional classrooms, such as access to subject-relevant media "field trips," access to "guest experts," and the opportunity to see practitioners apply the learning in a "real-world" setting. During interviews, principals mentioned each of these enrichment opportunities.

The projects tend only to keep enrollment records for full courses or instructional module series. Projects do not provide participation data for specialized media field trips. However, the few available examples indicate the value of the opportunity for participants. "Walking with the Dinosaurs" is a 90-minute, live interactive BSCN CETC broadcast with geologists and teachers at the site of a newly discovered clear bed of dinosaur tracks; 900 school districts requested the support materials for the broadcast, indicating active use of such enrichment modules. Last year, 10,868 students participated in similar modules through the Pacific Northwest STEP/Star project.

Distance learning also is used as a means to broaden the social experience of students and teachers. Principals mentioned the importance of their students being exposed to people living in other settings. Rural school staff members were particularly interested in having their students exposed to others studying the same subjects from different settings. (In response to this need in Cycle 3, TEAMS developed "Spotlight on TEAMS." These two half-hour modules are devoted to news of and exchanges among participating TEAMS students.) TEAMS and MCET organized data sharing with pen pals. The STEP/Star has regional conferences for students and studio teachers to attend. And Midlands sponsors "German Days," bringing together participating students in cultural festivals.

Computer networks also can serve this objective. In MCET and TEAMS, for example, students exchanged weather data with students in other states. Contact with others interested in challenging subject matter, such as calculus or physics, may reduce perceived isolation and provide colleagueship otherwise unavailable to students.

Exposure to multicultural educational experiences also broadens the social experience of distance learners. This may be equally important in rural settings serving students with limited exposure to diversity and in depressed, inner-city settings primarily serving low-income, minority students who may be as experientially isolated. Further, the latter group often is underrepresented in curriculum focus and material. Multicultural and/or bilingual programming may help address needs generated by the increasing ethnic and linguistic diversity of students entering schools.

Approximately 22 in-services are provided on these issues, representing 16% of the Star Schools in-service content.

Star Schools broadcasts also include community programs. Project staff members intend that schools with mandates to increase the level of school-community contact and/or parent involvement in the schools may use such broadcasts. Although little evidence of this was seen in the sites visited, principals at some sites mentioned their parent-involvement mandate and the intention to use the appropriate broadcasts for this purpose in the future. The *potential* of the distance-learning project to address this need was thus cited as one of a cluster of reasons for participation, but never as the reason for or the primary use of involvement. Further, not all projects have programs aimed at an audience of parents and community members. Those that carry such programming most typically provide parenting skills, gang and alcohol and other drug (AOD) awareness, English as a second language (ESL), or general equivalency diploma (GED) programs. One project found that few schools reported taking advantage of the opportunity for parent involvement. However, another project reported an example of community application in which several schools located on or near a reservation came together to view the Star Schools broadcast, "Northwest Native American Cultures." This was followed by community discussions about how the broadcast did or did not reflect particular elements of the participants' own cultures.

Finally, schools decide to participate in distance-learning activities to increase both student and teacher access to and comfort with modern technology. Some projects are built around computer-aided support material while others enable the participating schools to acquire a variety of technological equipment. Relevant in-services such as "Technology and Education in the New Curriculum" also are offered. Principals mentioned getting involved with Star Schools projects as motivated by the desire to have more technology integrated into classroom instruction.

Use of Technology

For the Star Schools projects funded in the first two cycles, the dominant distance-learning technology was via satellite. In Cycle 3, computer networking increased in importance, and a statewide fiber optics network was funded. Districts or schools used satellite dishes as downlinks to relay live studio broadcasts into the classroom(s). Project staff members do not know the extent to which satellite broadcasts were taped and not viewed live, although estimates range from 50% to 90%.

To enhance interactivity, each project provided an "audio bridge"—a single or series of telephone lines to connect classrooms directly with the studio teacher during the broadcast. Most (but not all) participating classrooms had a telephone. Some projects used the audio bridge on a

first-come-first-served basis, while others rotated systematically among schools so that each school or classroom would be guaranteed "on-air" time. The extent of interaction often depended on the initiative of the on-site facilitator. The amount of interaction also was a function of the total number of schools enrolled in the course or module: the larger the enrollment, the less access to on-air time.

Some projects also used the audio bridge immediately after a program aired, during specific "office hours" for the studio teacher and/or during prearranged tutorials with other staff. Audio-bridge time also was enhanced during special event broadcasts so that incoming calls were directed to several professionals in addition to the studio teacher.

The extent to which other technologies were used is in part related to program objectives. Whole-course instruction always used satellite technology that was usually enhanced with an audio bridge, computer networking (particularly electronic mail), compressed data transmission equipment, or fax machines. Supplemental instruction designed to enhance classroom teaching typically used more varied technologies.

MCET provided a menu of multiple technologies from which participating middle school teachers chose what was most applicable to their school, and all schools were provided with the needed equipment to use the technologies. An MCET report on teachers' use of technology indicates heavy reliance on those technologies that teachers themselves could schedule into their classroom day—computers, telephone, and television. Satellite programming, although a major focus of the MCET Star Schools project, was used far less intensively than any computer-related technology. It outranked only the fax machine and the laser disc player in frequency of use. The use of the laser disc player may be an underestimate because some teachers indicated that with so much to learn during the first year of operation, they had postponed learning how to use the laser disc player until after the grant period ended.

TERC offered a variety of computer-based technologies and was the only Star Schools project during either Cycle 1 or 2 that did not use satellite programming. TEAMS' technology more closely resembles that of full-course instruction; it provides satellite programming with an audio bridge and extensive classroom materials for its supplemental math and science modules.

Satellite-based and computer-based technology applications differ in two fundamental ways. First, the satellite-based distance-learning activities are generated from a central point and sent out to receiving sites while computer-based applications frequently included information sharing that begins at the school site. Second, satellite-based distance-learning activities are scheduled by the provider. When school personnel wish to use such programming live, they must schedule other

courses and activities around the broadcast. In contrast, the use of computer-based technology can be scheduled within a classroom. These differences seem to influence the choice of technology at the project level and how Star Schools distance learning is implemented at school sites. The Cycle 3 projects include a fiber-optic network and other flexible technologies, and study of their application at the school level will provide further information about implementing innovative technologies.

Cycle 3 projects also expanded the types of technology being used. This expansion is most notable in the newly funded projects, but previously funded Star Schools projects also are adding new technologies.

One new project uses electronic technology to provide supplemental math and science instruction to middle school students. The other new project relies on a fiber optics network.

The more experienced projects also have added new technologies. STEP/Star has adopted a compressed data transmission system to increase interaction between students and their distance-learning teachers. TEAMS plans to pilot test an electronic network to encourage teacher and student interaction. Finally, MCET, which always has used multiple technologies, has added technologies particularly appropriate for reaching community groups.

Effects

Student-Focused

Distance learning may affect students in multiple ways. First, distance learning may provide students with otherwise unavailable opportunities to pursue subjects or accelerated study. Second, distance learning may provide the means to address a variety of educational needs in traditionally underserved populations. Third, distance learning may affect student motivation, learning, and success.

This section describes the courses or modules that were made available for the first time through the Star Schools Program and the number of students enrolled in them. In this report, such data are drawn from project reports, buttressed by site visits and telephone calls to projects. Most often, projects provided little, if any, data on such characteristics as ethnicity, gender, or participation in Chapter 1 at the district-, school-, or course-enrollment level. In addition, some documentary data are two to three years old, reflecting when projects received Star Schools funding, while other data were provided by project staff quite recently. The most recent

information available is reported here. Program-level statistics are intended to be indicative rather than definitive, combining best estimates and extrapolations.[2]

The effects of distance learning on student outcomes are, at best, suggestive. Few projects collected outcome data, in part because of the short grant period. Some staff suggested that it might be premature to measure student impact after two years, particularly because there was a lengthy start-up period to acquire equipment. Where outcome data are provided, they are often of a limited nature.

Evaluation efforts would improve if future funding required projects to keep records of course-level enrollment and student demographic data, as well as specified outcome data, in order to assess which populations benefited from distance-learning opportunities. This is particularly pertinent given the concern for reaching historically underserved populations as well as reaching students in remote areas more generally. For example, projects typically report the percentage of Chapter 1-eligible schools participating in the project, but have no information on the extent to which distance-learning participants are Chapter 1 students. The same issues pertain to the other target groups. Outcome data could include: course completion information, grades in full courses or courses with supplemental modules, attendance in broadcast instruction classes, and graduation rates of students formerly enrolled in high school distance-learning classes. The inclusion of comparison data where appropriate also would be helpful.

Program Offerings and Usage

Most Star Schools activities are intended to provide otherwise unavailable educational opportunities to students. Such opportunities may take the form of full courses that school personnel could not provide or enrichment modules infusing the curriculum with high quality instructional practices, materials, or more challenging content. Access to advanced technology is another opportunity provided through distance learning. Such access provides additional learning as students become comfortable using fax machines, interactive laser discs, computer networks, opti-scanners, and other equipment.

In settings without sufficient faculty breadth, schools may be unable to provide students with reasonable opportunities to meet graduation requirements. Further, in settings with narrow curriculum offerings, students interested in accelerated or specialized study may be denied educational opportunities available elsewhere. Historically, these limitations have affected the math and science attainment of low-income, minority, and rural students. Further, through contact with

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[2] One project, which is no longer operating, did not supply any data. Therefore, data are provided on seven projects.

students at other schools pursuing similar endeavors, academic interests are reinforced even when there are few local peers. And, through more adequate college preparation, students formerly graduating from institutions unable to provide them with competitive academic backgrounds may have a better chance to be accepted and succeed in college. At the start of the program, the number of projects offering AP courses underscored this application of distance learning.

The 1992-93 school year saw a major shift in the types of offerings through the Star Schools Program. Cycle 3 projects, even those that had received funding in earlier cycles, seemed to change their focus. Further, those projects that no longer received Star Schools funding experienced difficulties in maintaining enrollment in the high school mathematics and science courses. Consequently, the historical role of distance learning in providing students in isolated, rural areas and some urban students with highly challenging secondary- and college-level courses seems to be changing.

Table 2 presents information on the types of opportunities made available through Star Schools funding of distance-learning projects from 1988-92. It lists all regularly scheduled distance-learning subjects offered, whether courses or instructional modules. Specially scheduled enrichment modules and field trips are not included.

Table 2
Types of Courses Offered, 1988-92 (the number of currently offered courses is followed by the number in parentheses, which indicates offerings over the life of the program)

	Elementary school*	Middle school	High school	Totals by subject
Foreign languages	5 (5)	0 (0)	26 (27)	31 (32)
Mathematics	7 (7)	0 (4)	5 (9)	12 (22)
Science	6 (6)	7 (9)	6 (8)	19 (22)
AP courses	not applicable	not applicable	6 (8)	6 (8)
Humanities	6 (6)	1 (3)	1 (5)	8 (14)
Social science	0 (0)	0 (0)	3 (5)	3 (5)
Skills	1 (1)	2 (2)	1 (3)	4 (6)
Totals by school level	25 (25)	10 (18)	48 (65)	83 (109)

*Courses or modules intended for grades four-six are included in this category although some middle schools include those grades.

Access to foreign language represents the greatest number of new opportunities, accounting for 39% of all Star Schools content area instruction. Science and math account for 24% and 15%

of the instructional opportunities, respectively. The remaining subjects represent between 4% and 10% of instruction. Only one or two opportunities were provided for general skills development at each school level. General skills courses including Career Paths, which enrolls 899 students, are not included in the content area totals referred to in the following discussion.

There are major differences in the kind of content area opportunities offered at different school levels, however. Elementary school opportunities are fairly evenly spread across the four content areas. Each subject accounts for five to seven course offerings or 21 to 29% of the content-area programming. Program offerings intended for elementary school use have not changed, whereas high school and particularly middle school offerings have changed over the life of the program.

Middle school opportunities are largely generated through two projects, MCET and STEP/Star. (In addition, the TEAMS modules, intended for grades four-six, may be used in middle schools. They are included in the elementary school column in Table 2.) Therefore, all but one content-area course offered through Star Schools instruction for middle schools falls under the heading of science. However, in previous years, Star Schools programming for middle schools consisted of 53% science courses or modules, 27% math courses or modules, and 20% humanities courses or modules. Because so few projects target middle schools, what looks like a major shift in available opportunities came about because a single project dropped its middle school instruction.

The greatest range of distance-learning opportunities is provided at the high school level, with content-area courses in six subjects. Foreign language instruction accounted for 55% of all content-area opportunities provided through Star School instruction at the high school level. AP courses, including math and science AP courses (13%), other science instruction (13%), and other math instruction (11%) represented the second most frequently offered distance-learning opportunities. Social sciences (6%) and humanities (2%) were provided less often. Star Schools high school students also have had opportunities to improve their college preparation. In addition to the science and math offerings, six AP courses currently are available to the students. Finally, students have been provided opportunities for specialized study, not only within the math and science subjects, but within the social science area as well.

Language opportunities were offered only to elementary and high school students. This may raise an issue of continuity where students study foreign language in elementary school and then again in high school following a two- to three-year gap in their learning if the students are involved in both. Current data do not provide information about this matter.

A major change in the types of opportunities available to students through Star Schools seems to be occurring. Much of the programming offered in the third cycle of Star Schools is supplemental middle school instruction. In the first two funding cycles, 50% of the course offerings were in high school mathematics, science, or foreign language. In contrast, the number of elementary and middle school courses in math and science has increased, with 30% of the programming currently targeted to the younger students. The number of high school classes in the areas of foreign language, science, mathematics, and advanced placement has decreased by at least half. During the 1993-94 academic year, only one project will offer math and science courses to high school students.

Table 3 indicates the 1992-93 courses offered by the Cycle 3 projects that received funding in earlier cycles.

Table 3
1992-93 Course Offerings as Compared to Cycle 1 and 2 (includes only those projects with previous Stars Schools funding)

	Elementary school		Middle school		High school		Totals by subject	
	92-93	Cycle 1 and 2 funding	92-93	Cycle 1 and 2 funding	92-93	Cycle 1 and 2 funding	92-93	Cycle 1 and 2 funding
Foreign languages	4	5	0	0	12	27	16	32
Mathematics	6	7	0	4	4	9	10	20
Science	7	6	15	9	1	8	23	23
AP courses	n/a	n/a	n/a	n/a	4	8	4*	8
Humanities	0	6	0	3	0	5	0	14
Social science	0	0	0	0	0	5	0	5
Vocational/learning skills	0	0	0	2	9	3	9**	6
Totals	17	25	15	18	30	65	62	108

The data on course offerings indicate a change in the focus of the Star Schools Program in line with the change in language in the 1991 reauthorization. Originally, the program provided access to students, primarily in rural areas, unable to receive science and mathematics courses, including AP courses. The second cycle of funding added a second focus to the original emphasis:

* This includes world geography, micro and macroeconomics, English and calculus.
** This includes classes for high school students and adults.

providing urban students with access to enrichment opportunities that they would not normally have, both through student-oriented programs and activities designed to improve teaching.

The reauthorization stimulated increased attention to "integrating programs into the class curriculum," which seems to have had the effect of increasing the number of supplemental offerings at the elementary and middle school levels. The Star Schools Program includes few programs that integrate distance learning into high school class curricula. As the Star Schools program currently stands, enrichment opportunities for both rural and urban students are expanding, particularly in the areas of math and science at the elementary and middle school levels.

The largest decrease in course offerings is in the area of full-course math and science at the high school level. During the first funding cycle, projects primarily funded high school math, science, and foreign language courses. The full courses previously offered by projects included physics, chemistry, calculus, algebra II, probability and statistics, discrete math, and AP math and science. Only one project continues to offer these math and science courses through the Star Schools program. There were only one high school science course and one AP mathematics course offered during 1992-93. There are no high school science or AP math courses being offered during the 1993-94 academic year. However, one newly funded project is providing supplemental math and science instruction at the high school level.

There are two reasons for the decrease in high school math and science courses. First, of the Cycle 3 projects, only two focus on high school instruction. When the Department of Education selected the Cycle 3 projects for funding, the changed legislative emphasis tended to increase the number of projects with elementary or middle school programming. Six of the eight projects are designed to provide distance learning to elementary and middle school populations.

Second, according to project staff members, it is easier to sustain elementary and middle school course enrollments than it is to maintain high school enrollments in science and mathematics courses. Only one project is providing such programs during the 1993-94 academic year. In contrast, enrollment in high school foreign language courses has been stable. The two projects offering foreign language courses have successfully provided foreign language instruction to thousands of high school students. The languages offered include Japanese, Russian, Spanish, and Latin.

At this stage of the study, only speculation about the reasons is possible. It may be that the decreased demand for high school level math and science reflects greater school capacity to offer such courses. An equally plausible, although contradictory, explanation is that there is a decline in the number of rural students interested in challenging coursework in math and science. A third

explanation may be that stand-alone science and math courses have a higher per unit cost than other courses so it takes greater enrollment to sustain them.

In addition to elementary and middle school math and science instruction, there has been an increase in the availability of vocational and learning skills courses. These courses are targeted to adults as well as middle grade and high school students. Consistent with the Star Schools Program Assistance Act goals to provide literacy skills and vocational education, the projects include such classes as General Equivalency Diploma (GED), English as a second language (ESL), and career/vocational instruction. One project has organized vocational and literacy skills classes through community groups and uses school facilities to provide instruction to parents and community leaders. These classes often are offered at untraditional times, such as early in the morning or early evening, thus giving people who work an opportunity to attend. Another project has expanded its community focus while using non-Star School Program funds to support its traditional offerings.

Student use of opportunities. Star Schools provides opportunities in a number of areas. How well do students use those opportunities? How many schools use the Star Schools Program? How many students take advantage of which opportunities?[3] This section presents data about student enrollment from 1988 until the 1992-93 academic year.

The data presented have some limitations. First, Cycle 3 Star Schools projects report student enrollment in courses developed through Cycle 1 and 2, but we do not have such data from Cycle 1 projects that no longer receive funds. More important, the Cycle 3 projects are able to maintain their identity as Star Schools projects and this may affect their relationships with schools and have an impact on enrollment. Further, information about enrollments in courses offered by one Cycle 1 project is not available.

The Star Schools Program has a truly national reach, serving 3,491 schools across 48 states and Washington, D.C. Only Hawaii and Maryland have yet to officially participate in Star Schools distance-learning opportunities. Tables 4, 5, and 6 provide student enrollment in content-area courses and module series, except at the elementary school level. Projects provided little data about enrollment in specific distance-learning opportunities in elementary schools. Summary data

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[3] We have anecdotal reports of other uses of Star Schools-sponsored activities but will only report official school enrollments. Therefore, home learning and other uses will not be reported. One project has a decentralized production and dissemination structure and, therefore, currently is unable to provide course-by-course use data. For this reason, elementary school breakdowns are incomplete. However, data concerning enrollments in all courses were provided. In addition, one course in another project has no enrollment data.

are included in Table 4 for middle school content-area offerings and Table 5 for high school courses. Table 6 provides a summary by content area.

Table 4
Middle School Content-Area Offerings Through Star Schools Programming (a number preceding the course indicates the number of such courses offered [usually through different projects])

Humanities	Current enrollment	Math	Current enrollment	Science	Current enrollment
Basic English & reading (remedial)	592	Math	not offered	Applied science	1,410
		Math I	not offered	Biology	1,170
2 music history	not offered	Math II	not offered	Earth science	not available
		3-D geometry	not offered	Environmental science	not available
				3 science	2,563
				2 science & technology	1,488
Total humanities:	592	Total math:	0	Total science:	6,631

Table 5

Enrollment in High School Courses Offered Through Star Schools Programming (a number preceeding the course indicates the number of such courses offered, usually through different projects)

AP	Current enrollment	Foreign languages	Current enrollment	Humanities	Current enrollment	Math	Current enrollment	Sciences	Current enrollment	Social sciences	Current enrollment
AP English	226	French I	383	African arts	not offered	Algebra	not offered	Anatomy & physiology	113	Applied economics	not offered
2 AP calculus	302	French II	200	Art history	89	Applied geometry	not offered	Astronomy	430	Geography	not offered
AP chemistry	not offered	2 German I	1,781	2 Music history	not offered	Applied math	127	Biology	not offered	Honors world geography	274
AP American government	not offered	2 German II	601	English composition	not offered	Calculus	63	Marine science	444	Psychology	437
AP physics	687	3 Japanese I	2,301			Discrete math	313	2 Physics	479	Sociology	359
AP macro-economics	163	3 Japanese II	965			Precalculus	89	Principles of technology	86		
AP micro-economics	205	2 Latin I	1,134			Probability & statistics	347	Science	not offered		
		2 Latin II	285			3-D geometry	not offered				
		Mandarin Chinese	not offered			Trig./analytic geometry	not offered				
		2 Russian I	640								
		2 Russian II	322								
		Elem. Spanish	413								
		2 Spanish I	1,797								
		2 Spanish II	808								
Totals	1,583		11,630		89		939		1,552		1,070

Total high school students served: 16,863

Table 6

Summary: Use by Content Area (totals may count individuals more than once where the same students took more than one course (enrollment for current middle and high school content area courses and module series only)

	Elementary school	Middle school	High school	Content totals
AP courses	not applicable	not applicable	1,583	1,583
Foreign languages	not available	0	11,630	11,630
Humanities	335	592	89	681
Mathematics	24,355	0	939	25,294
Science	24,354	6,631	1,552	32,537
Social science	0	0	1,070	1,070
Unspecified	19,725	0	0	19,350
School totals	68,844	7,223	16,863	93,955

At least 92,580 elementary, middle, and high school students are enrolled in content-area courses or modules. In addition, 1,713 middle and high school students currently are enrolled in the following general skills classes: "Career Paths" (899 students), "Thinking to Learn" (818 students), and "American Sign Language" (21 high school students). This brings the total served to 93,955. Further, thousands of middle school and high school students also take advantage of media field trips and special workshop opportunities through Star Schools. In the only project to track student participation in these single broadcasts, enrollment across such enrichment modules was more than double the enrollment across content-area courses (10,659 as opposed to 4,209). If this is a representative example, we would expect to find a minimum of 50,000 middle and high school students served through single enrichment broadcasts and media field trips. Thus, the best estimate of students served sets a minimum of 140,000 students, not including two elementary school courses for which we have no enrollment data and also not including home-learning students of all ages.

Clearly, students take advantage of the distance-learning opportunities provided through Star Schools broadcasts, particularly in the target areas of math, science, and foreign languages.

Types of students served. Less clear is the degree to which the disadvantaged and traditionally underserved populations are being reached through Star Schools distance learning. All projects serve Chapter 1 students, minority students, and educationally disadvantaged students. However, the level at which data are provided makes it difficult to assess how many students in these groups are direct participants. Demographic course enrollment data are needed. From the

information available, it appears that 57% of students served are minorities[4] (39% African American, 6% Asian, 11% Latino, 1% Native American/Alaskan Native, >1% other minority); 40% are educationally disadvantaged[5]; and 77% are from Chapter 1-eligible schools[6]. The extremely limited data available indicate that the target groups are being served.

However, additional data are needed about the distribution of distance-learning opportunities. The large numbers of minority students involved, for example, result from the existence of activities that focus on urban school districts. In general, these activities are intended to enhance existing curricula and involve fewer contact hours than full courses.

Student Outcomes

Three student-level effects of distance learning, in addition to the enrollment and use patterns reported above, are of interest. First is the effect of distance instruction on learning. This can be demonstrated through outcome data such as passing grades in the courses, gains in achievement, and good performance on tests. Second is the effect of distance learning on student interest and motivation, for which only indirect outcome indicators are available. Third is the effect on student work as evidenced by special products. As will be discussed later in this report, little outcome data have been provided by the projects.

Four projects did not collect outcome data of any kind. Project staff referred to the need for longer treatment periods before one could expect to perceive impact on students. Two projects gathered information on student outcomes using a single method of assessment, and the other two used two methods:

1. One project reported grade distributions across their distance-learning courses.

2. Two projects formally assessed student performance through comparison tests with students receiving traditional classroom instruction. A third project used pre- and post-tests. In addition, a single site in a fourth project looked at changes in scores on norm-referenced tests.

3. Two projects surveyed teachers concerning the impact of distance learning on their students.

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4 Minority enrollment is based on five projects. One project tracked minority enrollment; the other four projects used a sample of districts served and estimated minority enrollment at the district level.

5 Indicators of educationally disadvantaged include: percentage of students on free or reduced lunch program, percentage of students in the state below the poverty level, percentage of LEP students, and percentage of students whose mothers have an educational level of grade 12 or below.

6 Four projects named participating Chapter 1 eligible schools; all other projects indicated that at least half of the schools served were Chapter 1 eligible.

4. Three projects surveyed or interviewed students to obtain feedback on the distance-learning experience.

The project reporting grade distributions offers full-course high school instruction in AP-level subjects, foreign languages, and specialized math topics. In this project, 88% of the distance learners earned a C or better in the broadcast course. Almost half (42%) of the students earned As. No comparison data are provided.

In both projects that used comparison tests, project staff members remain dissatisfied with the test. In one case they believed, although offering courses in the same content area, traditional classroom instruction and the distance-learning instruction were not actually comparable on a specific level of subjects covered. Students in distance-learning classes demonstrated lower levels of performance in all areas tested. In the second case, distance-learning groups performed better than their traditional classroom counterparts. However, items were changed between the pre- and post-test period, and 40% of the students did not finish the tests in the time intended, but returned to complete them. A third project used pre- and post-tests, demonstrating a 45% gain. Comparison groups were not used. One site looked at norm-referenced test scores of the participating Chapter 1 students and found gains for 16 of the 24 middle school students.

Teacher feedback was collected through formal interviews and/or surveys by two projects. In both instances, teacher reports were favorable. Teachers in one project reported that academically disadvantaged students were better served by distance learning than by traditional classes. They also reported that minorities and learning-disabled students had higher rates of attendance during distance-learning module days. Teachers in the other project also reported higher rates of attendance, but did not differentiate among types of students most affected. Teachers also reported that the hands-on approach resulted in observably higher levels of student motivation during broadcast instruction.

Student feedback also was elicited by two projects. Students in one project reported no significant differences between distance learning and traditional classroom learning, class cohesiveness, goal direction, teacher characteristics and skills, and teacher support. The other project had students complete course-specific evaluations. Across courses, 43% of the students said they believed they learned as much in Star Schools classes as they would have learned in traditional classes.

In addition, anecdotal illustrations of successful distance-learner performance were offered by a number of teachers, principals, and by the project staff across all eight projects. For example, in two projects, AP studio teachers reported that they believed AP distance learners were passing

AP tests at the same rate as those taking traditional classroom AP courses. The staff of one project pointed to the fact that three distance-learning foreign language students were among the top 10 finalists in a statewide Japanese competition. Another foreign language project reported project-taught students "sweeping" the state language competition for five years. Another project reported spontaneous student use of languages learned via broadcast.

Anecdotal information also is used to indicate strength of motivation among distance learners. One site reports that students drove up to 35 miles each way to receive broadcast instruction in algebra during the summer. Another site reports that students voluntarily gave up 15 minutes of their daily lunch period to receive broadcast instruction. Classroom teachers at several sites also stated that student attendance rates were better on broadcast days than otherwise. They attributed the increase in attendance to the teaching methods used during the broadcast module.

Outcome data are sketchy. However, what data are available suggest that for at least some courses, learning takes place, students are motivated, and work is accomplished. This also is the general opinion offered by project staff, principals, and classroom teachers and facilitators.

Staff-Focused

Those programs offering supplemental instruction, most notably TEAMS and MCET, were intended to change teachers' attitudes and behaviors in the classroom. Both TEAMS and MCET conducted surveys of participating classroom teachers on changes in instructional practices. In TEAMS, a strong majority (86%) of teachers responding to the internal evaluation survey reported using different instructional materials as a result of participating in the distance-learning instruction.

The internal evaluation surveys of MCET middle school teachers do not reveal appreciable changes in their views on science teaching and learning. They already supported hands-on science, interdisciplinary teaching, and cooperative learning prior to participation in project activities. Teachers appeared philosophically to already have taken a cognitive or constructivist approach to science education. However, teachers reported changes in their classroom behavior through participation in the Star Schools activities. They indicated an increase in the use of multiple technologies in the classroom (95% of teachers), innovative ways of teaching science (85%), interdisciplinary teaching (71%), cooperative learning (68%), hands-on science (57%), and team teaching (47%). Teachers also reported changes in classroom management strategies, with more emphasis given to organizing classes with small group activities (85% of teachers) and less given to lecturing to the whole class (69%). Classroom observers noted that the multiple technologies and hands-on activities created interest among students and that students were more responsible for their own learning. Observers also noted that teachers still had a long way to go in

asking students for explanations, having students use previous experiences to explain concepts, and planning how to group students to ensure maximum learning (Drexler & Kapitan, 1993).

Although there is self-report of changes in attitude and behavior, in neither project were changes reported in the staffing patterns in the schools.

Those distance-learning projects providing full-course instruction did not explicitly intend to change individual teacher attitudes or behavior. The adults in the classroom often were nonteaching staff whose primary responsibilities in the distance-learning classroom were for managing the classroom and distributing materials. In a few schools, there was anecdotal information that some facilitators who already were certified teachers improved their teaching skills, and there were reports that certified math teachers who supervised calculus courses became comfortable enough with the material to teach independent of the distance-learning course.

CONCLUSION

The Star Schools Assistance Program has been funding activities since 1988. The program is complex and encompasses at least two goals. First, the program provides seed money to projects to develop distance-learning programming and equip sites. Second, Star Schools has served as a focal point for demonstrating innovative uses of technology to advance educational opportunity and improvement. Although these two purposes are not mutually exclusive, their inclusion in the same program has led to stresses in the field. This section discusses the differences between the two goals, leading to recommendations about the future of the Star Schools Program.

Star Schools as a Seed Money Program

As a seed money program, the Star Schools Program provides equipment to producers and receivers of distance-learning programs. It also enables producers to develop additional programs that, it is assumed, will only require minor modification over time. That is, the bulk of funds is provided at the front end, when development and equipment costs are high. Then, fees, subscriptions, and in-kind contributions are supposed to provide sufficient funding for bringing on new schools and modifying courses. From this perspective, the purpose of Star Schools is to provide educational opportunities for students who do not have access to high quality instruction in particular areas, and such access can be provided if the high costs at the start are supported.

The seed money perspective, however, may be inappropriate for distance learning designed to equalize educational opportunity. Students in remote rural areas gain access to courses that otherwise would not be available, and students in low-income and educationally disadvantaged schools are provided with supplemental, and frequently enriching, educational experiences through Star Schools. However, the ongoing costs of participation may be greater than the schools can support. For example, rural schools are generally pressed for funds to support required activities, and urban schools are in what seems like a permanent state of fiscal crisis. There is some evidence, moreover, that schools either cannot or will not continue to pay fees for the courses offered through satellite-based technology when other options are developing.

Despite the limitations of the seed money perspective, there is value in assisting schools to gain access to high quality technology. School facilities are unequal in their ability to support educational applications of technology (Kozol, 1992). Seed money provided to schools to equalize their facilities and access to technology remains important. However, it is not enough. Schools also need ongoing support to purchase programs that provide their students with access to high quality educational opportunities.

Star Schools as a Demonstration Project

Star Schools has become the focal point for the U.S. Department of Education's efforts to explore innovative educational applications of technology. Along with satellite-based distance learning, which was quite new to schools at the inception of Star Schools, funded projects have applied a variety of technologies, including videodisks, compressed data transmission, and computer networks, to reach their goals. Currently, the Star Schools Program is working with fiber-optic technology in a special statewide demonstration, and projects are using computer networks to provide teachers with a wide range of information about instruction and curriculum. In addition, funded projects are using technology and various distance-learning delivery systems to assist teachers in major educational reform. This focus comprises a set of demonstration projects.

Demonstration projects are different from seed money projects both in process and outcome. On the process side, demonstrations involve developing programs and delivery systems that can be widely used. Such development requires systematic approaches, mainly R&D. The developer field-tests both the content and delivery system and adjusts them to meet the realities of the field.

Within the Star Schools Program, at least three Cycle 1 and 2 projects have worked to demonstrate the uses of varieties of distance-learning technologies to reform education. This focus is even more evident in Cycle 3. One finding from the first year of the Star Schools study is that using technology to support educational reform requires a different approach from using technology to equalize educational opportunity. In the latter instance, personnel at the receiving school need a moderate amount of technical support, which all Star Schools projects provided with a high degree of professionalism and attention to the field. In contrast, using technology to reform education requires greater amounts of support at the school site. The approach requires collaboration with teachers so they become comfortable with the technology, understand the cognitive and pedagogical demands of the reform, and are able to use the curriculum and instructional methods to advance student learning.

Projects working on reform, then, require sufficient time to develop educational applications of technology. When they bring innovative technology to teachers, it should be as "bug free" as possible, which entails fairly extensive field tests. The materials and approaches also must meet high standards, which rely on rigorous quality control that includes content experts. In addition, because educational reform rests on teachers' approaches to curriculum and instruction, they should be supported in their efforts to use technology and change educational practice. Regular and intensive staff development provide such support. Indeed, among the Star Schools-sponsored

activities that aimed at educational reform, the more successful projects used well-developed technology and provided fairly intensive ongoing support at the site level.

The demonstration aspect of the Star Schools Program, then, leads to different funding policies and approaches from those involved in equalizing educational opportunity. While a seed money approach, supplemented by subsidies for low-income schools and students, will accomplish the latter objective, the demonstration efforts require fairly long-term R&D approaches to funding.

Developing Distance-Learning Programs

The multiple goals of the Star Schools Program emerged continuously during the first year of the evaluation. Project staff members were particularly concerned that the evaluators understand their goals and problems. Many, both in project headquarters and in schools, held an image of the "typical" distance-learning program, which was full-course instruction in areas such as foreign language or advanced science, that some schools are unable to offer to their students. While such courses comprise a large amount of Star Schools programming, supplemental instruction and activities aimed at contributing to the reform of education comprise an equally large portion. Further, most Star Schools grantees are involved in developing educational applications of emerging technologies. In sum, the current Star Schools Program has at least three separate strands:

- improving equal educational opportunities, either by providing full courses or by supplementing classroom instruction;
- contributing to the reform of American education; and
- demonstrating educational applications of emerging technologies.

Congress should consider different approaches to each purpose. The following includes preliminary ideas about ways each might be approached.

Improving Equal Educational Opportunities

Distance-learning activities designed to improve equal educational opportunities can be funded in two ways. First, projects or schools can receive seed money grants that allow them to modify facilities and purchase equipment to implement distance-learning technologies. Seed money is particularly important for schools that serve low-income students because there is a relationship between the quality of the facilities and the income level of students.

The second support for distance learning should be student-based. That is, schools should receive funding to support distance learning based on the needs of students. In rural areas, a measure of curriculum isolation can be derived from the size and geographic location of schools. It is more difficult to derive a formula for urban students, but viewing distance learning as an approach to supplementing instruction for educationally disadvantaged students provides one way of considering the problem. Money also can be allocated for gifted, low-income students.

In considering this alternative, Congress should engage in broad consultation in order to develop an equitable formula.

Contributing to the Reform of American Education

Distance learning and other applications of technology hold great promise for contributing to educational reform efforts. Exploiting that promise, however, requires that activities such as those sponsored by Star Schools be more closely tied to other reform efforts than currently is the case. Over the long term, both distance learning and educational reform will benefit from a close relationship.

To facilitate the integration of distance-learning technology into educational reform, OERI could fund special demonstration projects. Just as a demonstration of a statewide fiber-optics network currently is allowed by legislation, Congress could authorize OERI to provide grants to applicants demonstrating the contribution of distance learning to reform efforts. Such grants should include sufficient time to develop materials and delivery mechanisms and sufficient funds to provide support to teachers and other school-site personnel. Without specific authorization, such demonstration projects could become a priority area for funding within OERI grants programs.

Demonstrating Educational Applications of Emerging Technology

Rapid developments in communication technology provide a challenge to educators and an opportunity for the U.S. Department of Education to assume leadership. OERI should create a program that supports R&D regarding educational applications of emerging technology. This should be a long-term program that fosters experimentation with a variety of technologies and the integration of technological applications. It also should foster uses for student learning and motivation as well as staff development and the continuing professional development of teachers and administrators.

The technology R&D program should be closely aligned with other OERI research and improvement efforts. While giving opportunities for educational technologists to experiment, it also should require field tests of particular applications that include assessments of utility and usability. Technological applications may change the ways schools operate, but their entry will be to schools as they are currently structured. Consequently, the R&D program should include research about integration of new approaches with current practice.

Creating a long-term R&D program will increase attention to development activities and separate them from service activities. Current Star Schools grantees are rightfully uncomfortable about engaging in much experimentation while they are being judged in terms of their delivery of distance-learning services. Separating the purposes into separate programs enables OERI to provide continuous leadership and ongoing service in technology.

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